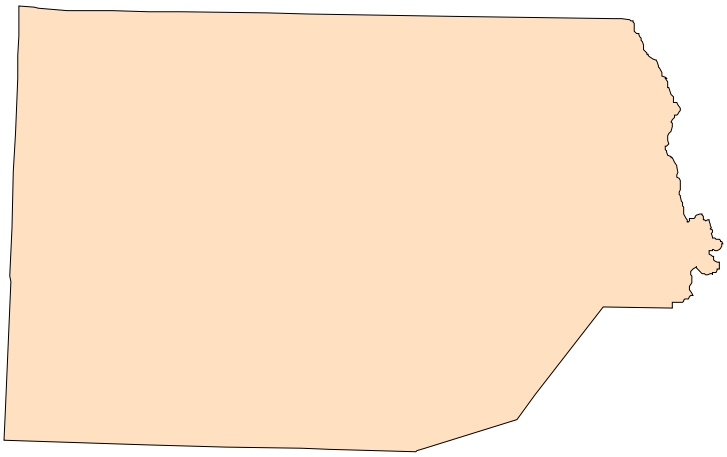
PART IV-BOX ELDER COUNTY ANNEX RISK ASSESSMENT



GENERAL BACKGROUND INFORMATION

Box Elder County is located in the northwest corner of Utah extending from the western edge of the Wasatch Mountains to the Idaho border and then west to the Nevada border. Box Elder County is surrounded by Cache, Weber, Tooele, and Davis Counties, and is the fourth largest of Utah's counties. Created in 1856, it was named for its abundance of Box Elder trees throughout the County.

Early inhabitants of the County were prehistoric hunters and gatherers that roamed the area as early as 12,000 years ago. In the 1820s and '30s fur trappers, including Peter Skene Ogden and Joseph Walker explored the eastern and northern parts of the County. Permanent white settlement began in 1851 when a group of Mormon pioneers settled in present day Willard. The area was already inhabited by Shoshone Indians when the Mormon settlers entered the area. This resulted in livestock raids and violent confrontations between the Indians and the settlers. On July 30, 1863, Territorial Governor James Duane Doty negotiated the Treaty of Box Elder ending the conflict between the Shoshone Indians and the settlers. In 1856 the territorial legislature created Box Elder County from part of Weber County.

Box Elder is historically known for the Golden Spike National Historical Site where, in May of 1869, the driving of the Golden Spike, in Promontory, joined the Union Pacific Railroad from Omaha, Nebraska, and the Central Pacific Railroad from the Pacific Coast. A dramatization of that ceremony is reenacted every year, allowing visitors to witness the event.

The County contains rich farmlands consisting of 43% of the County's land use, and leads all Utah counties in the economic value of its' agricultural products. The standard crops are hay, grain, alfalfa, and the County is also known for its peaches and other fruit crops. Besides its agriculture, Box Elder County is home to several large manufacturing facilities including ATK Thiokol Propulsion Corporation, the single largest employer in the County which operates two rocket motor and missile plants and produces fuel for space vehicles. Autoliv, the automobile airbag manufacturer, is also a major employer which is expanding rapidly. Others include Nucor Steel, Vulcraft and LA-Z-Boy of Utah.

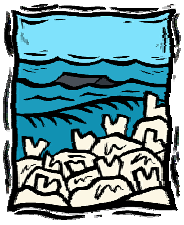
Box Elder County is a county whose economy and fortunes have been closely tied to individual industries throughout its history. Starting with early reliance on the opportunities made available by the trans-continental railroad, the sugar beet industry, and then most recently, the Thiokol Corporation and the military industrial complex.

The County recently has increased efforts to diversify its economy to avoid reliance on single markets and it shows signs of succeeding in this effort. The growth trend in Box Elder County is less rapid than Cache County but as the Wasatch Front becomes built out there will be increased pressure on Box Elder County to absorb future growth.

Although Box Elder County had its economic beginnings in agriculture and livestock production, manufacturers in the defense and space industry have given the county higher employment rates and per capita incomes than the rest of the state. Agriculture still plays a large part in the regional economy, but is increasingly seen as a source of supplemental income. Primary crops

include hay, silage corn and grain used to feed livestock and dairy herds. Only one-fifth of Box Elder County residents remain farmers. The manufacturing sector has diversified and grown at a steady rate in Box Elder County reducing the importance of agriculture to local economies. Simultaneously, employment opportunities have steadily moved from the agricultural sector to the manufacturing sector. Many employees have migrated from national and international locations for high paying jobs at ATK Thiokol Propulsion Corporation, a major aerospace and defense contractor that has historically been Box Elder County's largest employer. In fact, mostly because of Thiokol, Box Elder County has traditionally been a county of higher employment and higher per capita income than most Utah counties. (See the "Population Density and "Land Ownership" map in the map section of the county annex)

Table IV-9: Box Elder County Participating PDM Jurisdictions			
Box Elder County	Bear River City	Brigham City	Corinne City
Deweyville Town	Elwood Town	Fielding Town	Garland City
Honeyville City	Howell Town	Mantua Town	Perry City
Plymouth Town	Portage Town	Snowville Town	Tremonton City
Willard City			



BOX ELDER COUNTY FLOODING

Background

Areas in Box Elder County have experienced significant impacts related to flooding in the recently recorded history. Box Elder County has several large rivers and smaller tributaries that are susceptible to flooding. The Bear River is the largest river in the county. A hydroelectric dam is located on the Bear River shortly after it enters the county from Cache County. Located mostly in Cache County, Cutler reservoir is formed as a result of this dam. The existence of this dam does provide some meaningful flood control for downstream portions of the Bear in Box Elder County. Other major rivers are the Malad River and Box Elder Creek. A number of smaller often intermittent streams are located in some of the canyons of the Wellsville and Wasatch Mountains. Each of these streams can pose a threat in terms of flooding. In addition a number of canals are located in the county that under certain conditions may fail or overflow and result in flooding.

Most flooding in Box Elder County is attributed to snowmelt rates in surrounding watersheds that are in excess of the capacity of the drainage systems or unusually heavy storm events that temporarily overwhelmed drainage capacity (or a combination of the both). Some limited flooding is the result of rising groundwater levels. **See the "FEMA Flood Zone" Map in the county annex map section.**

History of Flooding in Box Elder County

In terms of property damage and disruption of community life, Brigham City along with the Willard/Perry area has been the communities most impacted historically by flooding. The floods of August 1923 in Willard were some of the most destructive in the State's recorded history. A significant portion of Willard was inundated by flood water and associated mud and debris flows. Four dwellings were destroyed and two women died when their homes were demolished (see cover photos).

In the mid-1980's large portions of Box Elder County were negatively impacted by the rise in the level of the Great Salt Lake. A significant amount of high value wetlands and agricultural land surrounding the lake were flooded by the rise of the briny water, including the Bear River Bird Refuge. Although their immediate value was reduced by a natural dry cycle that resulted in the lake level dropping, the State of Utah installed large pumps on the lake to moderate the rise of the lake by moving the water to the west desert. These pumps can return to operation if needed.

Following is a summary of significant flooding events in Box Elder County from 1847 to present:

Table IV-10: Box Elder County Flood History 1847-2003		
Location	Date	Description
Brigham City	1851	Box Elder Creek flooding through early settlement.

Table IV-10: Box Elder County Flood History 1847-2003		
Location	Date	Description
	1881, 1907	No information available
	Feb 1911	Snowmelt and heavy rain resulted serious damage to homes, roads and bridges.
	Aug 1947	Crop & road damage, flooded homes
	May 1957	Low area flooding
	Aug 1959	Extensive road damage
	June 1960	Crop damage
	June 1963	Crop damage and flooded homes
	June 1969	Main Street flooding and one home
	Spring 1983	Homes flooded, waste treatment plant threatened by Box Elder Creek.
Fielding	July 1957	Flooded highway, crop damage
	1958, 1979, 1980	No information available
Garland	1899, 1918,1980	No information available
	Spring 1983	Dike along Bear River failed and damaged community water supply pump house.
Honeyville	Spring 1983	Homes flooded from high groundwater
Howell	1968,1969,1980	No information available
Perry	May 1949	Road, orchard and crop damage
Plymouth	1891,1941	No information available
Promontory	Sept 1959	Crop damage
Snowville	June 1953	Crop damage, road closure
	1954, 1980	No information available
Thatcher	1934,1980	No information available
Willard	1906,1912	No information available
	Aug 1923	Widespread flooding and debris flow. Significant property damage and loss of life.
	Aug 1952	$100,00 in damage to orchard
	Sept 1982	Flooding from Holmes Canyon east of Willard. Road damage as flood waters crossed U.S. 89 at about 680 South.
	Spring 1983	Several homes flooded, Facer Canyon Flooding
Land around the Great Salt Lake	1982-1984	Flooding of land around the Great Salt Lake (wetlands and agricultural land).
Entire County	Spring 1984	Debris flows on private land, debris basins in Willard filled to capacity. Widespread road damage.
FEMA Flood insurance study for Brigham City, 2-17-81, Local Surveys (see appendix A) (Butler & Marsell, 1972), (Division of Comprehensive Emergency Management, 1981)		

Box Elder County Flood Hazard Assessment
Hazard Profile

Frequency	Some flooding occurs nearly every year in Box Elder County
Severity	Moderate
Location	Generally along rivers, streams and canals.
Seasonal Pattern	Spring flooding as a result of snowmelt. Mid-late summer cloudburst events.
Duration	A few hours or up to three weeks for snowmelt flooding
Speed of Onset	1-6 hours
Probability of Future Occurrences	High-for delineated flood plains there is a 1% chance of flooding in any given year.

Taken as a whole, Box Elder County has relatively minor flood threats. This, in part, is reflected in the low number of communities participating in the National Flood Insurance Program (NFIP). Nonetheless, significant flooding has occurred in the past and with certainty will occur in the future. The question is when, where and to what extent?

Given existing and potential future development, areas around the Bear and Malad Rivers are most likely to see impacts related to flooding. At present most of the risk for flood damage is centered on potential agricultural loses. Certainly as more development occurs, if it is not properly managed, threats to structures and human safety will certainly increase.

Analysis of areas of Box Elder County mapped by FEMA for communities that participate in the NFIP indicate some conflict related to existing development located in what has been determined to be the 100 year floodplain. Digitized floodplain maps for Box Elder County were overlaid on a layer of Digital Ortho Aerial Photographs as well as a 1996 data layer that delineates "developed" areas (Water Related Land use Study produced for the State of Utah Division of Water Resources). An August 2003 report Flood Hazard Identification Study: Bear River Association of Governments by the U.S. Army Corps of Engineers was also used to determine flood risk for communities that do not have FEMA Firm flood plain maps (See Appendix B for the full report).

Numerous isolated pockets of development (generally limited to 1-3 farmsteads) are located in the **unincorporated portions of Box Elder County**. Some of these isolated developments located largely adjacent to the Malad River and to a lesser degree the Bear River and various intermittent streams are at least partially located in the 100 year floodplain.

Other areas of concern related to risk of flooding are the development located on the south side of 600 north in **Brigham City** as it extends from about 900 west to 1200 west. This area, as well a couple of small isolated areas in the center of Brigham City are located in Box Elder Creek's 100 year flood plain. Small areas adjacent to 500 north from about 200 west to 400 west may be impacted by overflow flooding of Box Elder Creek. This would likely impact about 7-10 homes. The area west of Brigham City on 600 north would mostly impact industrial development.

The Ogden-Brigham (Pineview) Canal flows into Brigham City from the south. It enters the southern part of the county and flows through or above Willard, Perry and Brigham City. The Perry Canal begins in an equalization pond below Mantua Reservoir and flows partially through Brigham as it flows to Perry City to the south. These two canals parallel each other for a time flowing in opposite directions. Historically, not much flooding has occurred related to these canals. About three years ago the Perry Canal overflowed with spring runoff around 6th South 800 East in Brigham due to a blocked culvert a one home was flooded. Brigham City could be impacted by upstream conditions on the Pineview Canal (see Willard discussion).

Deweyville Town is located east of the Bear River. However all development is located considerable distance from the river and does not seem to be at risk from Bear River flooding. Some eastern tributaries flowing off the Wellsville mountains present a threat to portions of the town from site specific flooding. However not many drainage routes exist on the Western side of the Wellsville Mountains. The soil types present essentially absorb most potential runoff. Flows occur only on extreme weather events. A similar situation occurs for **Honeyville Town**. Deweyville does not participate in the NFIP and has not been mapped for flooding (See appendix B).

The Eastern portion of **Plymouth Town** appears to be vulnerable to flooding. The north eastern portion seems especially vulnerable. Because the town does not participate in the NFIP no flood plain map has been produced. Some approximation is required in carrying the flood boundary that has been mapped for the adjacent unincorporated county through the town of Plymouth. Nonetheless, it appears that about 7-10 residential units are threatened from flooding by these intermittent drainages (See Appendix B).

Snowville Town has several relatively large Deep Creek tributary drainages that are located in or near the town. Snowville does not participate in NFIP and so no official flood plain map has been produced for the town. Flooding from the intermittent tributaries would seem to pose a significant flood threat for a large portion of the community (See Appendix B).

Tremonton City does not participate in the NFIP as a consequence flood plains have not been delineated for the community. For the most part the community has no risk from flooding. However the eastern part of the community along the Malad River suggest that some flooding is possible in developed portions of Tremonton City. “The limited detail floodplains identified on the adjacent county map reflect what should be considered a minimal flood hazard area” (See Appendix B). If the rough extend of the Malad River floodplain boundary mapped for the unincorporated county carried through the Tremonton Boundary, approximately seven residences are threatened by flooding based on a 100 year event.

Willard City has experienced some of the worst flooding in the state’s history (see cover photos). Certainly many changes have occurred and improvements made since the flooding in the early 1900s. Nonetheless some flooding vulnerability still exists for residents of Willard.

Much of the steep mountainous area east of **Perry City** to the north, Willard and the South Willard area extending to the Weber County line on the south are drained by a number of steep mountain canyons. These include Facer, Willard, Cook, Holmes and Pearsons Canyons. A long

history of flood related problems have occurred in some of these canyons (especially above Willard City). Further exacerbating the situation is the presence of the Ogden-Brigham Canal (Pineview) that runs perpendicular to these canyon drainages at the base of the foothills.

Responding to flooding, significant flood control work has been completed in these drainages (much of it done by Civilian Conservation Corps (CCC) crews). Detention basins have been constructed at Facer Creek, Willard Creek and Pearson Canyon. Land terracing has been completed on the upper portion of the Willard Creek drainage. Gabions have been installed to direct flood waters in Pearson and Holmes Canyons. In addition a number of debris basins have been constructed.

Community officials have also attempted to respond to flood water from east-west canyons entering the northern flowing Ogden-Brigham Canal. Chutes have been built over the canal and most of the sections of the canal subject to flooding have been piped to prevent flood waters and debris from entering the canal. Also storm water pipes have been installed to help handle storm water discharges for Perry and Willard cities (RB & G Engineering, Inc, 1999).

Assessing Vulnerability: Identifying Assets & Estimating Losses

Table IV-11: Box Elder County Flood Risk Residential and Commercial

Jurisdiction Name	Population	Residential Development at Risk		Commercial Development at Risk (x 1000)	
		Units	Value	Units	Income*/Structures**
Bear River City	Incomplete data-No flood plain map (See appendix B)				
Brigham City	43	16	$1,743,539	6	$9,200/$2,057
Corinne City	2	1	$63,524		
Deweyville Town	Incomplete data-No flood plain map (See appendix B)				
Elwood Town	4	1	$107,650		
Fielding Town	Incomplete data-No flood plain map (See appendix B)				
Garland City	Incomplete data-No flood plain map (See appendix B)				
Howell Town	Incomplete data-No flood plain map (See appendix B)				
Mantua Town	28	8	$1,196,045		
Perry City	16	5	$702,453		
Plymouth Town	Incomplete data-No flood plain map (See appendix B)				
Portage Town	Incomplete data-No flood plain map (See appendix B)				
Snowville Town	Incomplete data-No flood plain map (See appendix B)				
Tremonton City	Incomplete data-No flood plain map (See appendix B)				
Unincorporated	258	75	$9,462,303	68	$87,000/$23,000

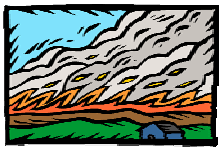
Population and Residential Development estimates are derived using 2000 Census data
*2002 estimated total sales revenue (Census)
** Based on average 2002 assessed commercial building value for Box Elder County
(2002 State Tax Commission Report & Box Elder County Assessor's Office)
Note: Communities not listed have no residential or commercial property identified in the hazard.

Table IV-12: Box Elder County Flooding Other Facilities at Risk				
Jurisdiction Name	**Critical Facilities**	**Roads**	**Power lines**	**Rail Lines**
Bear River City	Incomplete data-No flood plain map (See appendix B)			
Brigham City		.2 miles Interstate\$6 Million .9 miles two lane\$2.8 Million		.2 miles\$48,227
Deweyville Town	Incomplete data-No flood plain map (See appendix B)			
Elwood Town		.3 miles\$930,000		
Fielding Town	Incomplete data-No flood plain map (See appendix B)			
Garland City	Incomplete data-No flood plain map (See appendix B)			
Honeyville City	Honeyville School (closed)	1 mile Interstate\ $30 million 2.2 miles 2 lane\$6.8 million		.94 miles\$226,666
Howell Town	Incomplete data-No flood plain map (See appendix B)			
Perry City		.2 miles\$620,000		.05 miles\$12,056
Plymouth Town	Incomplete data-No flood plain map (See appendix B)			
Portage Town	Incomplete data-No flood plain map (See appendix B)			
Snowville Town	Incomplete data-No flood plain map (See appendix B)			
Tremonton City	Incomplete data-No flood plain map (See appendix B)			
Unincorporated		3.1 miles Interstate\$93 million 39.1 miles two lane\$121 million		6.07 miles\$1.5 million
See Appendix D for data sources and cost factors. **Note: Jurisdictions not listed have no identified facilities at risk.**				

Assessing Vulnerability: Analyzing Development Trends

The area south of Willard along Highway 89 to the Weber County line is posed to be the county's high growth area. This area is in the process of developing a sewer system to accommodate new development demand. Design proposals are being developed for as many as 1000 new housing units. Some of this housing demand will come from Weber County residences looking to relocate.

If not properly sited, new development along this corridor could very likely be vulnerable to flooding from adjacent mountain drainages. At least some of the new development growth is likely to go on the east side of U.S 89 above and below the Ogden-Brigham Canal. This poses a potential flood threat from the canal itself but also would add new stormwater runoff to the canal. It would be generated from the impervious surfaces of new development upslope from the canal. This could impact downstream residences in Willard City, Perry City and Brigham City.



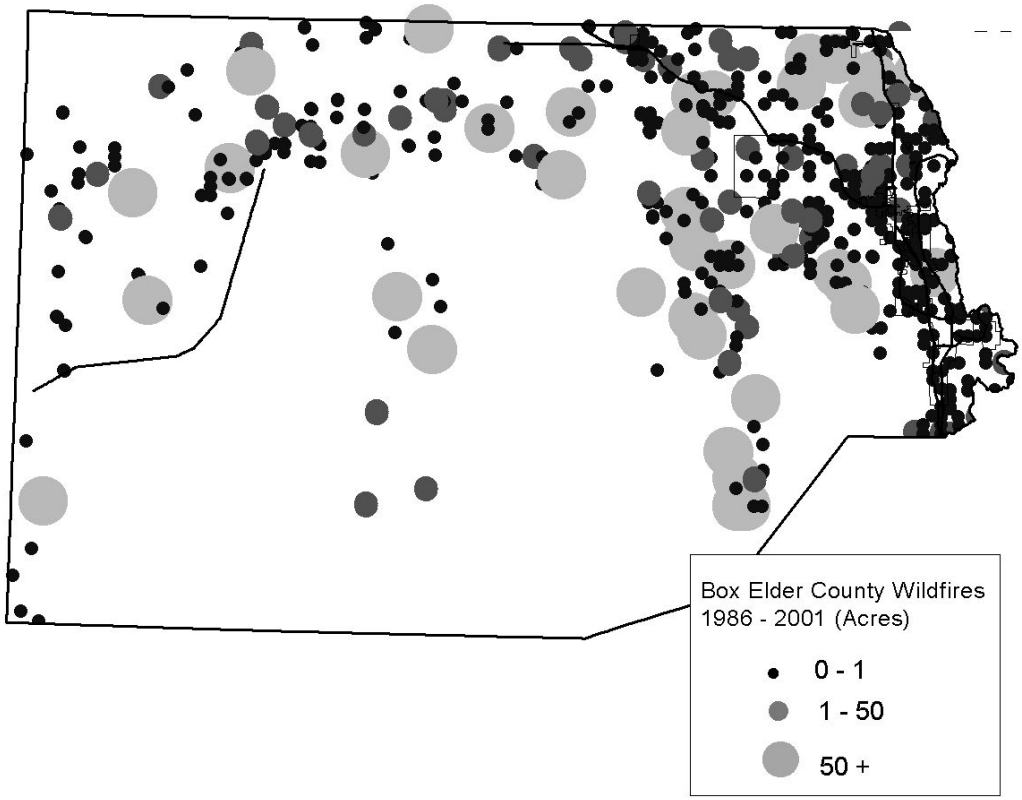
BOX ELDER COUNTY WILDFIRES

Background

The vast majority of Box Elder County has minimal threat from wildfire. Most of western Box Elder County is sage and scrub vegetation. In these areas when wildfires start they are relatively easy to contain and protect developed property. Where the highest risk occurs in Box Elder County is on the urban fringe and wildland interface primarily along the base of the Willard and Wellsville mountains. Some scattered second home developments are also at risk from wildfire. **See the "Wildfire Hazard" Map in the county annex map section.**

History of Wildfires in Box Elder County

Major fires in Box Elder County include the "Wildcat", "Fort Ranch", "Thiokol", "Pilot Peak", "Dry Canyon", "Morris Ranch", and "West Hills" fires. The following graphic illustrates the number and rough locations of wild fires in Box Elder County in the 15 year period from 1986 to 2001. In 1992 a large fire burned uncontained for over a week in the mountains above Perry City.



Box Elder County Wildfire Hazard Assessment
Hazard Profile

Frequency	Annually to some extent
Severity	Severe
Location	Dispersed throughout the whole county
Seasonal Pattern	Generally the worst from early July to mid September (depends on drought conditions)
Duration	A few hours to two weeks
Speed of Onset	1-6 hours
Probability of Future Occurrences	Very High (Based on data from 1986-2001, there is a 52% chance a fire of at least 1000 acres will occur every year)

A few subdivisions on the eastern edge of Brigham City are located immediately adjacent to wildfire prone areas.

Located in the unincorporated county north of **Deweyville Town** along the base of the Wellsville Mountains is located the Cedar Ridge Subdivision. Many of these homes are located in a high risk wildfire area.

Assessing Vulnerability: Identifying Assets & Estimating Losses

Table IV-13: Box Elder County Wildfire Risk Residential and Commercial

Jurisdiction Name	Population	Residential Development at Risk		Commercial Development at Risk (x 1000)	
		Units	Value	Units	Income*/Structures**
Brigham City	562	157	$20,213,196	7	$6,000\$2,400
Honeyville City	13	5	$674,928		
Mantua Town	28	8	$989,561	1	$100\$342
Perry City	30	9	$1,266,446		
Willard City	34	17	$1,430,014		
Unincorporated	340	95	$13,871,710	6	$33,000\$2,057

Population and Residential Development estimates are derived using 2000 Census data
*2002 estimated total sales revenue (Census)
** Based on average 2002 assessed commercial building value for Box Elder County
(2002 State Tax Commission Report & Box Elder County Assessor's Office)
Note: Communities not listed have no residential or commercial property identified in the hazard.

Table IV-14: Box Elder County Wildfires Other Facilities at Risk

Jurisdiction Name	Critical Facilities	Roads	Power lines	Rail Lines
Bear River City			1.2miles/$57,521	
Deweyville Town			1.1miles 345Kv line/ $53,035 7.2miles 138Kv line/$354,125	
Honeyville City			1.4miles 345Kv line/$67,500 3.5miles 138Kv line/$67,769	
Unincorporated			3.8 miles 345Kv line\$183,213 1.9 miles 230Kv line\$91,694 24 miles 138Kv line\$1.1 million	2.28miles/$549,788

See Appendix D for data sources and cost factors.
Note: Jurisdictions not listed have no identified facilities at risk.

Assessing Vulnerability: Analyzing Development Trends

The areas that expose development to the most risk from wildfires are often the most desirable places to live. These places afford residents good views, access to public lands, open space and a connection with nature. Most jurisdictions have found it difficult to restrict, limit or modify development proposals for these areas.

In terms of future development trends Brigham City, Willard, South Willard and Mantua will likely see the most growth pressure in these fire prone areas. Brigham City recently proposed extending its eastern town boarder to U.S 91 north of Mantua Town. News reports indicate as many as 300 housing units may be proposed for the area. This area is all classified as high or extreme in terms of wildfire hazard.

Development that is being talked about in South Willard (east of U.S. 89) could put numerous homes at risk from wildfire depending on where it is sited.

As Brigham City, Willard, Honeyville and Mantua continue to grow; development pressure will likely increase on the margins of town and the trend will likely be to develop higher on the foothills. Some of this risk is moderated by the presence of U.S. Forest Service land that will set some bounds on this trend in certain areas.

BOX ELDER COUNTY LANDSLIDES

Background

Landslides are most common in Box Elder County at the base of the Willard Mountains from Perry south to the Weber County line. Landslides do not pose much of a problem for other parts of the county. **See the "Landslide Potential" Map in the county annex map section.**

History of Landslides in Box Elder County

Table IV-15: Box Elder County Landslide Areas	
Active Landslides (in Acres)	Historically Active Landslides 1847 to present (in Acres)
490	103,770

Debris flows associated with the 1923 flooding of Willard City were very destructive and destroyed a number of homes and building. Main Street Willard was covered in a thick layer of mud, rocks and debris. The force was strong enough to move large boulders (See cover photo).

In 1949 a five mile stretch of U.S 89 between South Willard and Utah Hot Springs was covered with mud, rocks and boulder.

In late May 1983 a large landslide occurred on the face of the mountain north of Willard near Facer Creek. Also in 1983-84 Three Mile Canyon near Perry City experienced a mud slide. As a result over $1 Million was spend constructing a detention basin and overflow facilities.

Box Elder County Landslide Hazard Assessment
Hazard Profile

Frequency	Annually to some extent
Severity	Sever
Location	Dispersed throughout the whole county
Seasonal Pattern	Generally the worst from early July to mid September (depends on drought conditions)
Duration	A few hours to two weeks
Speed of Onset	1-6 hours
Probability of Future Occurrences	Very High

The Perry to South Willard area along the base of the Willard Mountains has had ongoing problems with debris flows, landslides and flash flooding. A number of debris basins have been constructed as well as other debris flow management structures. Portions of the Ogden-Brigham Canal susceptible to debris flow blockage have been placed in culvert to avoid flooding.

Assessing Vulnerability: Identifying Assets & Estimating Losses

Table IV-16: Box Elder County Landslide Risk Residential and Commercial (Active & Historically Active Landslides)					
Jurisdiction Name	**Population**	**Residential Development at Risk**		**Commercial Development at Risk (x 1000)**	
		Units	**Value**	**Units**	**Income*/Structures****
Brigham City	131	25	$3,156,549		
Deweyville Town	52	19	$2,673,932		
Honeyville City	458	136	$15,697,737	3	$600/$1,028
Perry City	37	17	$1,462,448		
Willard City	525	185	$23,748,463	10	$1,500/$3,438
Unincorporated	377	117	$16,021,369		
Population and Residential Development estimates are derived using 2000 Census data *2002 estimated total sales revenue (Census) ** Based on average 2002 assessed commercial building value for Box Elder County (2002 State Tax Commission Report & Box Elder County Assessor's Office) **Note: Communities not listed have no residential or commercial property identified in the hazard.** Data does not include areas susceptible to debris flows (no data available).					

Table IV-17: Box Elder County Landslides Other Facilities at Risk (Active & Historically Active Landslides)				
Jurisdiction Name	**Critical Facilities**	**Roads**	**Power lines**	**Rail Lines**
Deweyville Town		0.6miles/$1,860,000	0.1miles/$4,821	
Honeyville City		4.3miles/$13,300,000	0.8miles 345Kv line/$38,571 1.1miles 138Kv line/$52,727	.33miles/$179,575
Willard City	Police/Fire Station, Willard School	4.5miles/$13,950,000	0.8miles/$38,347	
Unincorporated		19.1miles/$59,210,000	1.2miles 345Kv line/$57,857 6.9miles 138Kv line/$330,745	2.42miles/$583,547
See Appendix D for data sources and cost factors. **Note: Jurisdictions not listed have no identified facilities at risk.** Data does not include areas susceptible to debris flows (no data available)				

Table IV-18: Box Elder County Landslide Risk Residential and Commercial (Active Landslides Only)					
Jurisdiction Name	**Population**	**Residential Development at Risk**		**Commercial Development at Risk (x 1000)**	
		Units	**Value**	**Units**	**Income*/Structures****
Perry City	9	3	$426,209		
Willard City	525	185	$23,748,463	10	$1,500/$3,438
Unincorporated	89	27	$3,366,168		
Population and Residential Development estimates are derived using 2000 Census data *2002 estimated total sales revenue (Census)					

** Based on average 2002 assessed commercial building value for Box Elder County
(2002 State Tax Commission Report & Box Elder County Assessor's Office)
Note: Communities not listed have no residential or commercial property identified in the hazard.

Table IV-19: Box Elder County Landslides Other Facilities at Risk (Active Landslides Only)

Jurisdiction Name	Critical Facilities	Roads	Power lines	Rail Lines
Willard City		.6 miles Interstate/ $18 million 3.5 miles two land/ $10.8 million	0.6 miles 138 Kv line/$28,760	
Unincorporated		.1 miles Interstate/ $3 million	.2 miles 138Kv line/$9,586	

See Appendix D for data sources and cost factors.
Note: Jurisdictions not listed have no identified facilities at risk. Data does not include areas susceptible to debris flows (no data available)

Assessing Vulnerability: Analyzing Development Trends

Any development on alluvial fans in the South Willard area could be problematic.

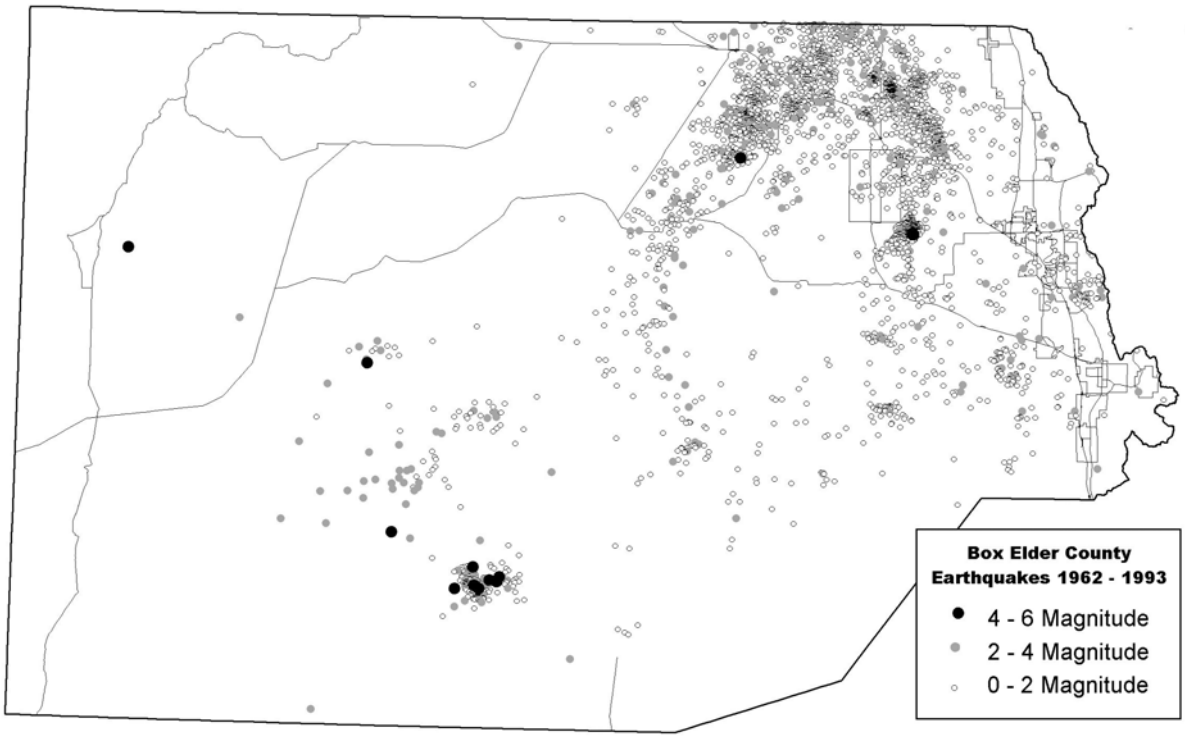
BOX ELDER COUNTY EARTHQUAKES

Background

The most populated portions of Box Elder County are located on the Intermountain Seismic Belt and the northern most segment of the Wasatch Fault. Earthquakes are common in Box Elder County, although no major earthquake resulting in significant property damage has occurred since European settlement. Geologic evidence establishes the possibility of a major earthquake in Box Elder County. **See the "Earthquake Fault Zone" and "Liquefaction Potential" Map in the county annex map section.**

History of Earthquakes in Box Elder County

The 1934 Hansel Valley Earthquake at 6.54 magnitude is widely held as the state's largest earthquake in modern recorded history (four aftershock earthquakes occurred ranging from 4.8 to 6.1 magnitude). The epicenter was in a largely unpopulated portion of the county and little or no property damage occurred. This earthquake resulted in surface fault rupture. Prior, in 1909 a 6.0 magnitude earthquake also occurred in the Hansel Valley.



Box Elder County Earthquake Hazard Assessment
Hazard Profile

Frequency	Low magnitude events occur frequently. Larger magnitude events are rare (although not necessarily on geologic time).
Severity	Potentially Catastrophic
Location	Entire County with highest frequency north of the Great Salt Lake. Surface fault ruptures are likely to occur in fault zones and liquefaction would impact most of the populated county.
Seasonal Pattern	None
Duration	A few minutes with potential aftershocks
Speed of Onset	No warning
Probability of Future Occurrences	Based on 1962-1993 data, there is a 50% chance every year of an earthquake of 4.0 magnitude or greater.

Much of the populated corridor in Box Elder County is located near the Wasatch Fault. According to Hecker (1992), the Wasatch Fault Zone is the longest and most active normal fault in the Utah. The Wasatch Fault extends from the south of Malad Idaho to western Sanpete County Utah, much along the populated Wasatch Front. Ten distinct segments have been identified along the fault that has similar characteristics.

Based on geologic evidence of the last 6000 years, of all the studied segments the Brigham City segment through most of Box Elder County is the most overdue for seismic release. Evidence suggests that it has been at least 3000 years since a significant release has occurred on the Brigham fault segment. All the other studied segments of the fault indicate faulting in the last 3000 years which suggests these segments have had release of seismic energy (Hecker, 1992).

Development in portions of **Brigham City, Perry, Honeyville and Willard** are located in areas that are susceptible to surface fault rupture in the event of a large earthquake.

Soil liquefaction presents the most widespread threat to **Box Elder County** inhabitants. Like most of the populated Wasatch Front, much of the population in Box Elder County is located on lake bed sediments from ancient Lake Bonneville. In addition areas with higher groundwater and more sandy soils present the highest risk. Problems related to soil liquefaction would impact a large percentage of the population in the event of a 5+ magnitude earthquake.

Assessing Vulnerability: Identifying Assets & Estimating Losses

Table IV-20: Box Elder County Earthquake Risk (Liquefaction) Residential and Commercial

Jurisdiction Name	Population	Residential Development at Risk		Commercial Development at Risk (x 1000)	
		Units	Value	Units	Income*/Structures**
Bear River City	750	233	$28,752,286	14	$7,600/$4,802
Brigham City	1,210	370	$44,449,661	90	$240,500/$30,876
Corinne City	619	206	$21,341,700	9	$13,000/$3,087
Deweyville Town	241	93	$13,167,183	2	$600/$686

Table IV-20: Box Elder County Earthquake Risk (Liquefaction) Residential and Commercial					
Jurisdiction Name	**Population**	**Residential Development at Risk**		**Commercial Development at Risk (x 1000)**	
		Units	**Value**	**Units**	**Income*/Structures****
Elwood Town	681	198	$26,823,488	7	$9,900/$2,401
Fielding Town	448	142	$15,765,197	8	$6,500/$2,744
Garland City	1,911	609	$31,668,000	34	$19,000/$11,664
Honeyville City	421	136	$17,335,932	16	$21,700/$5,489
Perry City	193	58	$8,688,271	1	$900/$343
Tremonton City	5,405	1,758	$193,749,291	241	$ 408,600/$82,679
Willard City	264	85	$10,460,115	9	$32,200/$3,087
Unincorporated	4,920	1,550	$186,181,315	133	$214,000/$45,628

Population and Residential Development estimates are derived using 2000 Census data
*2002 estimated total sales revenue (Census)
** Based on average 2002 assessed commercial building value for Box Elder County
(2002 State Tax Commission Report & Box Elder County Assessor's Office)
Note: Communities not listed have no residential or commercial property identified in the hazard.

Table IV-21: Box Elder County Earthquakes (Liquefaction) Other Facilities at Risk				
Jurisdiction Name	**Critical Facilities**	**Roads**	**Power lines**	**Rail Lines**
Bear River City	School	12.2miles/$37,820,000		
Brigham City	Discovery School	2.2miles Interstate/$66,000,000 17.2miles 2 lane/$53,320,000		7.06miles/$1,702,413
Corinne City	Fire Station	19.0miles/$58,900,000		4.23miles/$1,020,001
Deweyville Town		4.8miles/$14,880,000		4.06miles/$979,008
Elwood Town		3.6miles Interstate/$1.8,000,000 25.3miles/$78,430,000		3.32miles/$800,568
Fielding Town	Fire Station & School	8.0miles/$24,800,000		
Garland City	Middle School, Police Station, High School	1.27miles Interstate/$36,000,000 10.7miles 2 lane/$33,170,000		1.99miles/$479,859
Honeyville City	Fire Station	6.6miles Interstate/$198,000,000 17.4miles 2 lane/$53,940,000	2.8miles 345Kv line/$134,999 4.9miles 138Kv line/$233,877	7.01milles/$1,690,356
Howell Town				
Mantua Town				
Perry City		2.9miles Interstate/87,000,000 0.2miles 2 lane/$620,000	0.5miles 345Kv line/$24,107 1.0 miles 138Kv line/$47,934	3.74miles/$901,845
Tremonton City	North Park School, BRV Hospital, Fire/Police station, McKinley School	4.7miles Interstate/$41,000,000 27.7miles 2 lane/$85,700,000		3.88miles/$935,604
Willard City		4.37miles Interstae/$129,000,000	2.7miles 345Kv line/$130,178	4.76miles/$1,147,803

Table IV-21: Box Elder County Earthquakes (Liquefaction) Other Facilities at Risk				
Jurisdiction Name	**Critical Facilities**	**Roads**	**Power lines**	**Rail Lines**
		12.9miles 2 lane/$39,990,000	7.4miles 138Kv line/$354,711	
Unincorporated		29.6miles Interstate /$880,000,000 238miles 2 lane/$737,8000,000	17.9miles 345Kv line/$63,030 3.2miles 230Kv line/$154,432 46miles 138Kv line/$2,209,757	42.84miles/$10,330,223
See Appendix D for data sources and cost factors. **Note: Jurisdictions not listed have no identified facilities at risk.**				

Table IV-22: Box Elder County Earthquake Risk (Fault Zone) Residential and Commercial					
Jurisdiction Name	**Population**	**Residential Development at Risk**		**Commercial Development at Risk (x 1000)**	
		Units	**Value**	**Units**	**Income*/Structures****
Brigham City	715	208	$23,770,185		
Honeyville City	30	10	$1,149,286		
Perry City	14	5	$726,861		
Unincorporated	39	11	$1,558,940		
Population and Residential Development estimates are derived using 2000 Census data *2002 estimated total sales revenue (Census) ** Based on average 2002 assessed commercial building value for Box Elder County (2002 State Tax Commission Report & Box Elder County Assessor's Office) **Note: Communities not listed have no residential or commercial property identified in the hazard.**					

Table IV-23: Box Elder County Earthquakes (Fault Zone) Other Facilities at Risk				
Jurisdiction Name	**Critical Facilities**	**Roads**	**Power lines**	**Rail Lines**
Deweyville Town			0.1miles/$4,793	
Perry City				.74miles/$178,440
Unincorporated			0.1miles 345Kv line/$4,821 0.2miles 230Kv line/$9,662 0.9miles 138Kv line/$43,141	.87miles/$209,787
See Appendix D for data sources and cost factors. **Note: Jurisdictions not listed have no identified facilities at risk.**				

Box Elder County HAZUS Analysis

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates can be used by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The results of the model ran for Box Elder County simulates a 2,500 year event with an earthquake magnitude of 7.0.

Table IV-23: Box Elder County Human Casualty Estimates (HAZUS Model 7.0 Magnitude Earthquake)

Timing	Sector	Level 1	Level 2	Level 3	Level 4
2 A.M	Commercial	2	1	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	1	0	0	0
	Industrial	5	2	0	0
	Residential	77	19	2	4
	Single Family	292	75	10	20
	Total	378	98	13	25
2 P.M.	Commercial	183	57	10	19
	Commuting	0	0	1	0
	Educational	111	34	6	11
	Hotels	0	0	0	0
	Industrial	39	11	2	4
	Residential	15	4	0	1
	Single Family	60	15	2	4
	Total	407	122	20	39
5 P.M.	Commercial	173	53	9	18
	Commuting	0	0	0	0
	Educational	8	2	0	1
	Hotels	0	0	0	0
	Industrial	24	7	1	2
	Residential	29	7	1	1
	Single Family	115	30	4	8
	Total	349	100	16	30

Severity Level 1: Injuries will require medical attention buy hospitalization is not needed.
Severity Level 2: Injuries will require hospitalization buy are not considered life-threatening.
Severity Level 3: Injuries will require hospitalization and can become life threatening in not promptly treated.
Severity Level 4: Victims are killed by the earthquake.

Table IV-24: Box Elder County Building-Related Economic Loss Estimates in $ Millions (HAZUS Model 7.0 Magnitude Earthquake)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Loses	Wage	0.00	.63	9.21	.45	.41	10.70
	Capital-Related	0.00	.27	8.08	.26	.15	8.76
	Rental	12.66	5.33	5.02	.19	.19	23.40
	Relocation	1.14	.12	.23	.01	.06	1.57
	Subtotal	13.81	6.35	22.54	.91	.81	44.43

Table IV-24: Box Elder County Building-Related Economic Loss Estimates in $ Millions (HAZUS Model 7.0 Magnitude Earthquake)							
Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Capital Stock Loses	Structural	63.54	8.31	15.66	2.71	3.02	93.23
	Non-structural	223.05	38.39	41.57	9.68	7.63	320.32
	Content	52.40	7.83	18.76	6.11	3.50	88.60
	Inventory	0.00	0.00	.72	.96	.10	1.79
	Subtotal	338.80	54.53	76.70	19.47	14.25	503.94
	Total	352.80	60.88	99.25	20.38	15.07	548.37

Table IV-25: Box Elder County Transportation System Loss Estimates in $ Millions (HAZUS Model 7.0 Magnitude Earthquake)			
System	Component	Inventory Value	Economic Loss
Highway	Segments	1,731	0
	Bridges	195	42
	Subtotal	1,926	42
Railways	Segments	279	0
	Bridges	0	0
	Subtotal	279	0
Airport	Facilities	16	6
	Runways	91	0
	Subtotal	107	6
	Total	2,312	48

Table IV-26: Box Elder County Transportation System Loss Estimates in $ Millions (HAZUS Model 7.0 Magnitude Earthquake)				
Classification	Total	Least Moderate Damage > 50%	Complete Damage > 50%	Functionality >50% at day 1
Hospitals	2	2	0	0
Schools	27	16	0	1
Police Stations	6	3	0	0
Fire Stations	6	5	0	0
On the day of the earthquake the model estimates that only 5% of the hospital beds in the county would be available for patient use. After 30 day 72% of the beds are predicted to be operational.				

Table IV-27: Box Elder County Expected Building Damage by Occupancy (HAZUS Model 7.0 Magnitude Earthquake)										
	None		Slight		Moderate		Extensive		Complete	
	Count	%	Count	%	Count	%	Count	%	Count	%
Agriculture	0	.03	1	.01	1	.01	0	.02	0	.02
Commercial	4	.26	8	.24	21	.46	20	1	16	1.6
Education	0	0	0	0	0	0	0	0	0	0

Table IV-27: Box Elder County Expected Building Damage by Occupancy (HAZUS Model 7.0 Magnitude Earthquake)										
	None		Slight		Moderate		Extensive		Complete	
	Count	%	Count	%	Count	%	Count	%	Count	%
Government	0	.01	0	.01	1	.01	1	.03	0	.05
Industrial	1	.06	2	.05	4	.09	4	.23	3	.31
Religion	0	0	0	0	0	.01	0	.02	0	.02
Residential	50	3	150	4	339	7	326	18	216	22
Single Family	1,410	96	3,313	95	4,283	92	1,456	80	745	76
Total	1,465		3,474		4,649		1,808		980	

Assessing Vulnerability: Analyzing Development Trends

The development trend for many cities in Box Elder County has been to build further up in the foothills of the Wellsville and Willard Mountains. As cities get more "built-out" this trend will likely increase. This development will be exposed to risk associated with potentially unstable slopes or surface fault rupture in the event of an earthquake. New growth pressure in South Willard is of particular concern.

BOX ELDER COUNTY DAM FAILURE

Background

There are 261 regulated dams located in Box Elder County. Most of these dams are small detention ponds or livestock watering facilities and most pose a minimal threat to human safety or property.

Of the 261 regulated dams 250 are designated as "low hazard" by the State of Utah Division of Water Rights. As defined by state statue, low hazard dams are those dams which, if they fail, would cause minimal threat to human life, and economic losses would be minor or limited to damage sustained by the owner of the structure.

A total of 7 dams have been designated as "moderate hazard" by the State of Utah in Box Elder County. Moderate Hazard dams which, if they fail, have a low probability of causing loss of human life, but would cause appreciable property damage, including damage to public utilities.

The State of Utah has rated 4 dams in Box Elder County as "high hazard" which means that, if they fail, have a high probability of causing loss of human life or extensive economic loss, including damage to critical public utilities.

Dam failure inundation maps and emergency action plans for each of the high risk dams can be found on the Utah Division of Water Right's website at: http://waterrights.utah.gov/cgi-bin/damview.exe?Startup.

History of Dam Failure in Box Elder County

No significant dam failures have occurred in Box Elder County.

Box Elder County Dam Failure Hazard Assessment
Hazard Profile

Frequency	Rare
Severity	Potentially Catastrophic
Location	Areas down stream of failed dam.
Seasonal Pattern	Anytime. Highest risk in spring during snowmelt.
Duration	A few hours
Speed of Onset	No warning
Probability of Future Occurrences	Low

Assessing Vulnerability: Identifying Assets & Estimating Losses

Blue Creek Dam
The Blue Creek Dam is located one mile north of the town of Howell and has a hazard rating of high. The inundation area flows southward along blue creek, then just west of the development in Howell before ending at the Great Salt Lake basin.

Mantua Dam
The Mantua reservoir and dam have a high hazard rating. The inundation area covers the entire western side of the dam including significant amounts of the town of Mantua. Within the town, multiple homes and structures are at risk. The inundation continues westerly down Box Elder Creek filling the canyon bottom and covering highway 89/91, eventually leading through the center of Brigham City. Once again, significant numbers of people, homes and businesses are within the potential inundation area.

Three Mile Creek (debris and detention basin)
Three Mile Creek retention basin is located about 0.5 miles southwest of the city of Perry. The inundation area flows westerly from the dam towards the Great Salt Lake basin. Several structures as well as a section of highway 89/91 lie within the inundation area.

Cutler Dam
Cutler Dam and reservoir lie in extreme western Cache County and about four miles east northeast of Fielding in Box Elder County. This facility has a hazard rating of high. The inundation area follows the Bear River flood plain first southwesterly and then south past Deweyville, Elwood, Honeyville, Bear River City and finally Corrine City before ending at the Great Salt Lake. Since the inundation area remains, for the most part, within the flood plain, threats the population and homes appears to be minimum.

Assessing Vulnerability: Analyzing Development Trends

Any new downstream development that is located in the floodplain increases the exposure to risk in terms of human life and property. Given the relatively low probability of catastrophic dam failures, most jurisdictions are unwilling to regulate development in dam failure inundation areas.